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### Description

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#### A Thermal Barrier for a Cabinet

#### Technical Field

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The present invention relates generally to thermal barriers for use in a temperature controlled cabinet and more particularly to a thermal barrier curtain that allows the air from within the cabinet to circulate to the storage area of the cabinet door.

#### Background of the Invention

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Commercial businesses as well as private homes commonly use refrigerators to preserve the freshness of food by regulating the temperature to a level sufficient to slow food aging and to reduce contamination by bacteria. Consumption of food contaminated with bacteria often results in what is generally called food poisoning and is a common problem with improperly stored foods.

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Shell eggs are among the most nutritious foods and are recommended as part of a healthy diet, but they are extremely susceptible to the bacteria *Salmonella Enteriditis*. *Salmonella Enteriditis* attaches to the shell surface during the egg laying process or when the egg comes in contact with feces prior to collection. Much of the bacteria is removed during the washing and sanitizing process prior to sale, however as with most processes, they may not eradicate all of the bacteria. In addition if an egg rests against already contaminated food or is handled with contaminated hands, the bacteria may be

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5 reintroduced on the eggshell. Bacterial growth is  
facilitated when condensation accumulates on the exterior  
of the eggshell surface often times resulting when the  
refrigerator door is opened. Because of this several  
government agencies recommend not leaving eggs at ambient  
10 temperature for more than two hours after refrigeration.

The safety of shell eggs has been a long term  
problem and has prompted the Federal Drug Administration  
(FDA), Animal Plant Health Inspection Service (AIPHIS),  
Food Safety and Inspection Service (FSIS), Agricultural  
15 Research Service (ARS), National Agricultural Statistics  
Service (NASS), as well as state agriculture departments  
and state and local health departments to cooperate to  
ensure the safety of shell eggs from farm to table. On  
August 27, 1999 the FSIS ruled that shell eggs packed for  
20 consumers must be stored and transported under  
refrigeration at an ambient temperature not to exceed  
45°F. However, the recommendation for home storage of  
eggs by the FSIS is even stricter. The FSIS recommends  
consumers transport eggs immediately to a refrigerator  
25 and store them immediately at or below 40°F to decrease  
the likelihood of *Salmonella Enteriditis* contamination.

The FSIS suggests keeping eggs within the coldest  
region of the refrigerator and not in the storage door.  
However, even with this warning many consumers still keep  
30 their eggs in the door of the refrigerator. Moreover,  
many manufacturers have incorporated removable egg trays  
that fit in the storage door and still others have molded  
egg trays built into the storage door. These  
conveniences offered by manufacturers further encourage  
35 consumers to store eggs in the door of the refrigerator.

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The Association of Home Appliance Manufacturers ("AHAM") has adopted a standard voluntary testing protocol (ANSI/AHAM HRF-1-1988) recognized by the American National Standards Institute ("ANSI") for testing the efficiency of home refrigerators. The protocol measures the temperature at strategic points in the interior refrigerator and freezer chambers over time while opening and closing the door at defined intervals. AHAM standards allow consumers to identify which refrigerators use less power and which better maintain the set temperature under conditions of normal consumer use (i.e. when refrigerator doors are frequently opened and closed during the day).

Various forms of thermal barriers have been developed in an attempt to reduce the power consumption by refrigerators. Thermal barriers reduce the interaction between the cold interior air of the refrigerator and the warmer outside ambient air. The result is a refrigerator that uses less power to retain the set temperature by reducing loss of the cold air when the door is open. Examples of such known devices are disclosed in U.S. Pat. Nos. 2,041,258, 4,109,484, 4,288,992, 4,313,485, 4,400,046, 4,429,548, 4,539,819, 5,431,490. Generally, these devices create a barrier between the inner cabinet and the outer environment by providing rigid drawers or doors, a draped over

5 horizontal curtain, or a hanging vertical curtain. However, these devices are intended and designed to isolate a refrigerated chamber without a storage door. Unfortunately, a storage door is a common feature in many brands of household and industrial refrigerators.

10 U.S. Pat. No. 5,431,490 ("490") has incorporated the use of a hanging vertical thermal barrier with vertical slits in a refrigerator having a storage door. Unfortunately the '490 invention does not continually retain a storage door temperature at or below the FSIS  
15 requirement of 45°F when performing the AHAM test.

As previously discussed, current devices allow the efficient storage of food by creating thermal barriers in refrigerators that do not have storage doors. However, these thermal barriers are unable to maintain  
20 temperatures in food storage doors that meet the FSIS recommendations. Therefore, there is a need for a thermal barrier that allows efficient cooling of the storage door while minimizing the loss of coolness from the freshness chamber when the door is open.

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#### Brief Description of the Figures

FIG 1 is a perspective view of a device of the present invention having a protrusion strip mounted in a refrigerator demonstrating alignment of the flaps when  
30 the cabinet door is opened.

FIG 2 is a perspective view of a device of the present invention mounted in a refrigerator demonstrating the displacement of alternating flaps by a protrusion strip when the cabinet door is closed.

35 FIG 3 is a graphical representation of temperature variation of the door storage area using the thermal

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FIG 4 is a graphical representation of temperature  
variation of the freshness chamber using the thermal  
barrier of the present invention versus the anti-  
convection current curtain of the '490 patent wherein the  
cabinet door is opened a set number of times over the  
thirteen hour test period.

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In accordance with the present invention a thermal barrier for a cabinet is provided having a door storage area comprising a curtain having vertical slits dividing the curtain into flaps; an attachment device for securing the curtain within the cabinet; and a displacement apparatus for displacing at least one of the flaps from alignment with adjacent flaps when the cabinet is closed allowing air within the cabinet to circulate to the door storage area. The flaps may overlap adjacent flaps, the flaps may be constructed of a translucent material, and the device may further comprise stabilizing adapters affixed to the flaps such as weights.

In one embodiment of the present invention the  
35 attachment device may further comprise a mounting means  
and a connecting rod. The mounting means may be a bracket

5 that may be mounted on the upper surface of the cabinet  
or on the two opposing sides of the cabinet. The  
connecting rod may be adjustable in length and may be  
rotatably affixed to the mounting means. At least one  
flap may be connected to the connecting rod such that  
10 when the connecting rod rotates the at least one flap is  
displaced from alignment with adjacent flaps.

In another embodiment the displacement apparatus may  
comprise at least one protrusion that contacts at least  
one flap displacing the flap from alignment with adjacent  
15 flaps when the cabinet is closed.

In yet another embodiment the displacement apparatus  
comprises an activation shaft connected to the connecting  
rod such that when the cabinet is closed the activation  
shaft activates the connecting rod rotating the  
20 connecting rod causing the displacement of at least on  
flap from alignment with said adjacent flaps.  
Alternatively the activation shaft may activate the  
connecting rod when the cabinet is opened.

In still another embodiment of the present invention  
25 the displacement apparatus comprises an electrical motor  
connected to the connecting rod and a light sensor such  
that when the cabinet is closed the sensor activates the  
motor to rotate the connecting rod causing the  
displacement of at least one flap from alignment with the  
30 adjacent flap. Alternatively, the sensor may be activated  
when the door is opened to rotate the connecting rod  
causing the at least one displaced flap to come in  
alignment with non-displaced adjacent flaps.

In another aspect of the invention a thermal barrier  
35 for a cabinet having a door and an inner chamber, the  
door having a storage area and the inner chamber having

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5 an upper surface, a lower surface and two opposing side  
walls is disclosed comprising a curtain having vertical  
slits dividing the curtain into flaps; an attachment  
device for securing the curtain to the upper surface; and  
10 a displacement apparatus for displacing at least one of  
the flaps from alignment with adjacent flaps when the  
cabinet is closed allowing air within the cabinet to  
circulate to the storage area within the door. The  
attachment device may secure the curtain from the two  
opposing sidewalls.

15 In other aspects of the present invention a kit is  
disclosed comprising a thermal barrier described above as  
well as in another aspect of the present invention a  
method for reducing the temperature within the door  
storage area utilizing a thermal barrier described above.

#### 20 Detailed Description of the Invention

There are several disadvantages of the anti-  
convection current curtain of the '490 patent used to  
maintain the temperature within a controlled temperature  
25 cabinet. Specifically the anti-convection current  
curtain disclosed in the '490 patent does not efficiently  
or effectively allow cooling of the door storage area  
because the curtain seals this area from the freshness  
chamber. In particular the curtain is fastened to the  
30 cabinet above the freshness chamber preventing  
circulation above the curtain. Further the curtain  
extends the width of the freshness chamber preventing  
circulation around the curtain. In addition when the  
door is closed the shelf pushes against the curtain  
35 sealing the storage area at the contact point between the  
shelf and the curtain preventing circulation through the

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5 swing individually air is also allowed to pass through the gaps formed in the curtain. This problem may be enhanced when in a humid environment primarily because the moisture may cause the curtain to adhere to the storage shelf with the door when opened.

10 In addition, when the door is closed the air within the freshness chamber is compressed and pushes outward allowing them to become pinched between the door and cabinet. Like the securing technique, the pinched flaps weaken the magnetic seal between the door and the cabinet  
15 and may allow refrigerated air to escape and may also prevent the door from closing. In addition pinching may cause the permanent damage to the curtain. The result is a curtain that no longer hangs properly allowing air to escape from the freshness chamber.

20 Referring now more specifically to FIG. 1 the curtain (12) of the present invention does not seal the storage area within the door from the freshness chamber (10) when the door is closed because by displacing at least one flap from alignment with adjacent flaps, air is  
25 free to circulate through the curtain (12) when the door is closed.

The curtain disclosed in the present invention does not interfere with the magnetic seal between the cabinet (10) and the door because the curtain of the present  
30 invention is positioned on the interior of the cabinet (10). Therefore the seal is not compromised with the present invention.

The curtain (12) disclosed in the present invention is not displaced when the door is opened because the  
35 curtain (12) does not rest against the storage area shelves when the door is closed.

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5 In addition when the displacement apparatus (16) is  
a rotating connecting rod the displacement occurs by  
rotation, and rotation minimizes the angle between the  
attachment device (14) and the lower portion of the  
displaced flap. When the displacement apparatus (16) is  
10 a protrusion strip, the angle between the lower portion  
of the at least one displaced flap and the attachment  
device (14) is minimized by placing the curtain (12)  
within the freshness chamber.

The displacement apparatus (16) disclosed in the  
15 present invention is not adaptable to the device  
disclosed in the '490 patent.

In particular a rotating rod can not be adapted to  
the cabinet of the '490 patent because the curtain is  
secured to the outer surface of the chamber by a double-  
20 sided adhesive tape.

The attachment of the curtain (12) within the  
freshness chamber is also not adaptable to the device  
disclosed in the '490 patent. The securing technique  
disclosed in the '490 patent teaches the use of a double-  
25 sided adhesive tape to secure the curtain. Unfortunately  
the upper surface of the inner chamber is often times  
uneven and may have design characteristics such as vents,  
ducts or thermostat that prevent proper alignment of the  
curtain which can result in creation of gaps between the  
30 flaps.

In accordance with the present invention a thermal  
barrier for a cabinet (10) having a door storage area  
comprising a curtain (12) having vertical slits dividing  
the curtain into flaps; an attachment device (14) for  
35 securing the curtain (12) within the cabinet (10); and a  
displacement apparatus (16) for displacing at least one

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5 of the flaps from alignment with adjacent flaps when the cabinet (10) is closed allowing air within the cabinet to circulate to the door storage area.

#### I. The Curtain

10 The curtain (12) may be made of any material known to those skilled in the art that has poor thermal conductance, a low ionic static charge storage capacity, and acts as a thermal insulator. The material used to construct the curtains is dependent on the temperature  
15 within the cabinet. In particular, the curtain (12) may be utilized for a variety of purposes such as for a refrigerator or oven. When the curtain (12) is to be utilized for a refrigerated chamber the curtain (12) is preferably made of a material that is able to retain a  
20 portion of its flexibility at low temperature such as below 32°F to about -25°F and may have a thickness of from about 0.004 mm to about 0.040 mm, preferably from about 0.01 mm to about 1.00 mm, and most preferably from about 0.01 mm to about 0.25 mm. Preferably the material is a  
25 polymer and most preferably a translucent polyvinyl or polypropylene polymer.

When the curtain (12) is to be utilized for a heated chamber the curtain (12) is preferably made of a material that is able to retain a portion of its rigidity at  
30 higher temperatures such as temperatures above 200°F to about 500°F and may have a thickness of from about 0.004 mm to about 0.040 mm, preferably from about 0.01 to about 1.00 mm, and most preferably from about 0.01 mm to about 0.25 mm. Preferably the material is a polymer such as  
35 silicone.

5           The curtain (12) may have one or more vertical slits  
dividing the curtain into flaps. The vertical slits may  
extend from the base of the curtain (12) to about the top  
of the curtain or may extend to the top of the curtain  
(12) dividing the curtain into separate distinct flaps.  
10   The flaps preferably are of the same length extending  
from the top of the cabinet (10) to the base of the  
cabinet (10) such that the chamber formed interferes with  
the circulation of ambient air with the temperature-  
controlled air within the cabinet. The flaps may have the  
15   same or differing widths ranging from about 2 inches to  
about 18 inches, preferably from about 3 inches to about  
8 inches and most preferably about 4 inches to about 5  
inches. The flaps may be aligned side by side or they may  
overlap. If the flaps overlap they may form an exterior  
20   flap layer and an interior flap layer.

## II. The Attachment Device

The attachment device (14) may be any device known to those skilled in the art that may be used to secure the curtain to the inner chamber of the cabinet (10). In another configuration, the attachment device (14) may be composed of two or more parts that allow the curtain (12) to be affixed within the inner chamber such as for example a rod that supports the curtain (12) and at least one bracket for mounting the rod within the cabinet (10). In the first configuration the curtain (10) may be provided with connectors that allow the user to select and apply the desired connector to the curtain (12) and cabinet (10). For example providing the curtain (12) with a self-laminating Velcro strip so that the user may attach one section of the strip to the upper portion of

5 the curtain (12) near the top edge and the other section of the strip to the top wall of the cabinet (10). Once the Velcro sections are in place the curtain may be hung within the cabinet (10) by re-associating the Velcro sections.

10 In the other configuration the attachment device (14) comprises at least one mounting means and a connecting rod. The mounting means may be a bracket comprising one continuous piece that is aligned parallel to the connecting rod or may comprise two components one  
15 at each end of and generally perpendicular to the connecting rod. When the bracket is one continuous piece, the bracket may be constructed so that it is adjustable to fit a variety of cabinet (10) widths. For example the bracket may be composed of two sections wherein one  
20 section is slidably affixed within the other section similar to the telescoping curtain rods used in the window covering industry. Alternatively the two sections may be provided as two interconnecting pieces that may be secured in a desired length by nut and bolt or by clip.

25 The one continuous piece bracket may be secured to the top wall of the cabinet (10) or to the opposing sidewalls by a variety of methods such as screws, rivets, Velcro™, or adhesive. When two brackets are used they may be affixed one on each of two opposing side walls,  
30 preferably as close as possible to the top of the inner chamber and in close proximity to the door of the cabinet (10). The bracket may be constructed of any rigid material able to withstand a wide variety of temperature extremes as well as the weight of the curtain during such  
35 temperature extremes. Preferably the bracket is made of metal or temperature resistant polymer.

5 The connecting rod may be any rigid elongated shaft on which a curtain (12) or curtain flaps may be affixed, that may be mounted to the mounting means and allows at least one flap to be displaced from alignment with its adjacent flaps when the cabinet is closed. The connecting rod may be of fixed length or adjustable in length. If the connecting rod is adjustable it may be, for example, provided as two interconnecting pieces that may be secured in a desired length by nut and bolt or by push lock. The connecting rod may be mounted in the mounting means by a variety of methods known to those skilled in the art. For example, the mounting means may provide a cradle, clip or loop such that each end of the connecting rod may be placed into a cradle or attached to a clip or inserted into a loop. When in position the connecting rod may be stationary or may rotate. Alternatively, the connecting rod may be affixed to the mounting means and the mounting means may rotate. The curtain (12) or curtain flaps may be fastened to the connecting rod directly or it/they may be provided with an adapter on one end that may be slipped onto the connecting rod. For example an adapter may be created by folding over the top of the curtain or curtain flap to form a loop that may slip over the connecting rod. If the flaps or curtain (12) are fastened to the connecting rod so that they move with the rotation of the connecting rod they may be fastened directly to the rod for example by screw or adhesive, or they may be affixed to an adapter on the connecting rod such as for example a metal plate

5 III. The Displacement Apparatus

10 The displacement apparatus (16) may be any apparatus known to those skilled in the art that allows at least one flap to be substantially removed from alignment with its adjacent flaps allowing the air within the cabinet (10) to circulate into the door storage area when the door is closed. For example a displacement apparatus (16) could be a protrusion strip that physically displaces the curtain flaps by pressing against the flaps when the door is closed. Alternatively, a mechanical displacing  
15 apparatus may be utilized that converts the mechanical energy created by closing or opening the door to activate the rotation of the connecting rod displacing one or more curtain flaps. In addition an electronic displacing apparatus may be utilized comprising a light sensor that  
20 activates an electronic motor causing the rotation of the connecting rod when the presence or absence of light is detected.

25 When the displacement apparatus (16) is a protrusion strip, any device that is able to be mounted to the cabinet door and able to push against at least one flap such that it is substantially displaced from contact with its adjacent flaps is preferable. In one configuration when the flaps of the thermal barrier overlap the protrusion strip pushes against the flaps of the interior  
30 flap layer. If the cabinet door comprises at least one shelf, the protrusion strip may be mounted to the shelf such that when the door is closed the protrusion strip displaces at least one curtain flap. The protrusion strip may be mounted to the cabinet door by a variety of  
35 methods including adhesive, snaps or Velcro. The protrusion strip may be made of a variety of materials

When a device is utilized to rotate the connecting rod the rod may be rotated by a variety of methods known to those skilled in the art including a device activated by the opening of the cabinet door or alternatively by the closing of the cabinet door. The rotating device may be activated mechanically or electrically. For example the device may be mechanical such that when the door is opened an activation rod is released that rotates the connecting rod such that the curtain flaps are realigned from their displaced position when the door was closed. Alternatively, the activation rod may rotate the connecting rod when the door is closed displacing one or more of the curtain flaps.

If the displacement apparatus (16) is mechanical it may comprise two springs, the first spring activates the  
35 connecting rod to rotate displacing at least one flap when the cabinet door is closed and a second spring



5 activates the connecting rod to rotate in the opposing  
direction allowing the at least one flap is aligned with  
adjacent flaps when the door is open. Both springs may be  
affixed to the connecting rod such as by connecting one  
10 end of each spring to a tongue affixed to the connected  
rod. The other end of the first spring may then be  
connected to either the bracket or the cabinet. The  
other end of the second spring may be affixed to an  
activation shaft slidably connected to the bracket such  
15 that when the door is opened the pressure exerted by the  
door on the activation shaft is released and the  
connecting rod is rotated bringing the displaced flaps in  
contact with adjacent flaps. The bracket may further  
comprise a stopping component that prevents the  
20 connecting rod from rotating beyond the point in which  
the flaps are aligned when the door is open.

Correspondingly an electronic device that comprises  
a light sensor maybe utilized to rotate the connecting  
rod. For example when a refrigerator door is opened the  
light inside the refrigerator illuminates, when this  
25 occurs the light sensor activates an electronic motor  
that rotates the connecting rod aligning the curtain  
flaps. Alternatively, the sensor maybe activated by the  
absence of light such that when the cabinet door is  
closed the sensor registers the absence of light and the  
30 electronic motor is activated rotating the connecting rod  
and displacing at least one curtain flap. In these  
configurations one or more of the flaps may be connected  
directly to the connecting rod and thereby displaced when  
the connecting rod is rotated. The remaining flaps  
35 comprise adapters that allow the connecting rod to rotate  
freely without rotating these remaining flaps. The

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5 preferred form is for the flaps to alternate such that  
only every other flap is fastened directly to the  
connecting rod. The remaining flaps may be looped over  
the connecting rod such that when the connecting rod  
rotates the flaps fastened to the connecting rod rotate  
10 and are displaced while the remaining flaps do not rotate  
with the rod.

In another configuration the electronic motor may be  
activated by a push button located along the door jam  
such that when the door is closed the connecting rod is  
15 rotated displacing at least one flap and when the door is  
opened the connecting rod is rotated to re-align the  
flaps with other adjacent flaps.

#### IV. The Stabilizing Adapters

20 The stabilizing adapters (18) may be any adapters  
known to those skilled in the art that reduce flap  
movement during the opening and closing of the cabinet  
door yet allow the flaps to be displaced once the cabinet  
door is closed. For example the adapters (18) may be  
25 weights affixed or affixable near the base of the flaps  
or the adapter (18) may be an elastic cord that  
interconnects and aligns the base of the flaps. When the  
stabilizing adapters (18) are weights the weights may be  
provided in a variety of configurations and structures  
30 and may be affixed near the base of the flaps by a  
variety of methods such as snaps, clips, adhesive,  
magnetism, or by inserting a weight into a pocket  
provided at the center of the base of the flaps. The  
weights may be made of a variety of materials that  
35 increase the downward tension on the flap such as for  
example metal, high-density polymer, cement, stone or

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5 sand. The preferred weight is comprised of two components  
of equal weight that may be snapped together through an  
aperture made in the lower portion of the flap such that  
approximately one half of the stabilizing weight is on  
the interior side and the other is on the exterior side  
10 of the flap. Weights may not be required if the flap is  
constructed of a material heavy enough to prevent the  
movement of the flaps when the door is opened or closed.

When the stabilizing adapter (16) is an elastic  
cord, the cord may be affixed to the base of each flap by  
15 a variety of methods such as for example stitches, glue,  
or staples. Alternatively, the elastic cord may be  
affixed to the flaps by sliding the cord through a loop  
created at the base of the flap. The elastic cord may or  
may not be affixed to the interior cabinet. Preferably  
20 the elastic cord is affixed to the inner cabinet by for  
example tying the cord to metal loops attached to the  
inner cabinet sidewalls.

#### V. Installation

25 The controlled temperature within the door storage  
area of a cabinet may be maintained utilizing a thermal  
barrier of the present invention.

The thermal barrier device may be provided as a kit  
comprising a curtain (12), an attachment device (14), and  
30 a displacement apparatus (16). The curtain (12) may be  
provided as a single piece or as at least two flaps. In  
one preferred configuration the curtain (12) is provided  
as a single piece that is pre-slitted such that when cut  
into two pieces at 90° to the slits provides a curtain  
35 (12) with free hanging flaps for two different chambers  
such as a freshness chamber and freezer of a

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5 refrigerator. Alternatively, at least two separate flaps  
may be provided in which loops are preformed at each end  
such that they may be cut into two individual flaps.  
When two flaps are created from one, both flaps may be  
for the same compartment in the cabinet or they may be  
10 for different compartments such as one for a refrigerator  
and one for a freezer. Preferably the curtain (12) is  
provided on the connecting rod. In this configuration  
alternate flaps are affixed to the connecting rod such  
that when the connecting rod is rotated the affixed flaps  
15 are displaced.

The attachment device (14) may be selected from any  
of those that have the desired characteristics described  
above. Preferably the attachment device (14) comprises  
two brackets and an adjustable connecting rod. Preferably  
20 one of the two brackets further comprises a displacement  
apparatus (16) as described above. The two brackets are  
securely affixed to the two opposing sides such that the  
bracket comprising the displacement apparatus (16) is  
affixed to the wall adjacent to the door hinge and such  
25 that the connecting rod is parallel to the upper surface  
of the inner chamber.

The displacement apparatus (16) may be selected from  
any of those having the desired characteristics as  
described above. Preferably the displacement apparatus  
30 (16) is a mechanical device comprising an activation  
shaft affixed to a bracket and in contact with the  
connecting rod by a spring such that when the door is  
opened the activation shaft is released and the  
connecting rod is rotated bringing the displaced flaps in  
35 alignment with adjacent flaps. Correspondingly, when the

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The kit may further comprise stabilizing adapters (18) as those described above. Preferably the adapters (18) have an attachment mechanism that allows penetration of the curtain upon installation at the base of the flaps.

## Examples

Procedure for Determining the Temperature within the  
Freshness Chamber and the Door Storage Area for a  
Refrigerator With and Without a Curtain

The test unit was an eighteen cubic feet Frigidaire Crown Series F44N18DT refrigerator with a freezer top. The temperature measurements were taken over a twelve-hour period and power measurements over a thirteen hour period, including a 1 hour steady state measurement. The electrical power was recorded at the compressor input with an Extech #382860 True RMS Power Multimeter plugged into the electrical circuit and the Frigidaire unit. Recording of the electrical current was taken every fifteen seconds and temperature was recorded every two

5 minutes. The temperature readings were recorded with a  
 Fluke 52 Series II Dual Thermocouple Thermometer. The  
 dual thermocouple readings were taken at the upper  
 interior storage door and the mid interior chamber area.  
 Other temperature readings were taken with the Createware  
 10 DR-80 industrial dial refrigerator/freezer thermometers.  
 The Frigidaire cabinet conditions were as follows: the  
 ambient room temperature was seventy degrees, the cabinet  
 was level, there was an eighteen inch clearance area  
 around the cabinet, the freezer was set at the warmest  
 15 temperature setting, and the Frigidaire temperature was  
 set to six on a one to nine scale with nine being the  
 coldest.

The procedure was to open the refrigerator door  
 between 45° and 90° for fifteen seconds at predetermined  
 20 time points. The time points were as follows: no pulls  
 during the first hour providing a steady state  
 measurement, one pull during the second hour, eight pulls  
 during the third hour at seven and one half minute  
 increments; four pulls during the fourth hour at fifteen  
 25 minute increments; four pulls during the fifth hour at  
 fifteen minute increments, one pull during the sixth  
 hour, one pull during the seventh hour, one pull during  
 the eighth hour, one pull during the ninth hour, four  
 pulls during the tenth hour at fifteen minute increments,  
 30 four pulls during the eleventh hour at fifteen minute  
 increments, eight pulls during the twelfth hour at seven  
 and one half minute increments, and one time during the  
 thirteenth hour.

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#### Example 2

Cooling Efficiency Comparison of the Anti-Convection  
Current Curtain ('490) and a Thermal Barrier of the

5     Present Invention in the Door Storage Area Following the  
          Procedure Described in Example 1

Analysis was performed of hour 3 to determine the cooling efficiency of the storage area. Hour three  
10 comprised eight pulls at seven and one half-minute increments. Referring more specifically now to FIG. 3 the lowest temperature within each seven and one half-minute cycle was averaged to determine the average low obtained by each device. Results show that the device  
15 disclosed in the '490 patent was able to cool the storage door to an average temperature of 45.1°F during the seven and one half minute cycle. In contrast the present invention cooled the storage door to an average temperature of 39.6°F during the seven and one half-  
20 minute cycle significantly below the FSIS safety recommendation of 45°F. This study suggests that the present invention is more efficient than the device disclosed in the '490 patent at retaining the set temperature within the storage door.

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Example 3

Cooling Efficiency Comparison of the Anti-Convection  
          Current Curtain ('490) and a Thermal Barrier of the  
          Present Invention in the Freshness Chamber Following the  
30           Procedure Described in Example 1

Further analysis was performed of hour twelve to determine the efficiency of each device in retaining the set temperature within the freshness chamber. Hour twelve  
35 comprised eight pulls at seven and one half-minute increments. Referring more specifically now to FIG. 3

5 the highest temperature within each seven and one half-minute cycle was averaged to determine the average high obtained by each device. Results show that the standard refrigerator had an average high of 50.8°F, the device disclosed in the '490 patent had an average high  
10 temperature of 43.7°F, and the present invention had an average high of 35.2°F. This study demonstrates that the present invention is more efficient at retaining the temperature within the freshness chamber than a standard refrigerator and the device disclosed in the '490 patent.

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#### Example 4

Power Use Results from Testing the '490 Device and the Present Invention versus a Control (No Barrier) According to the Procedure in Example 1

20 Power consumption was measured over the thirteen hour testing period to compare the power required by a standard refrigerator and a refrigerator equipped with the thermal barrier of the present invention. Referring now specifically to FIG. 4 the results demonstrate that  
25 the standard refrigerator consumed 1.24 kWh while the refrigerator equipped with the thermal barrier of the present invention consumed only 1.09 kWh over the thirteen hour test period. Consequently, the refrigerator equipped with the thermal barrier of the present  
30 invention utilized 12.10% less power than the standard refrigerator.

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